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GUN-SHOT INJURIES

OF THE

KNEE JOINT,

REQUIRING

AMPUTATION.

BY

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GUN-SHOT INJURIES OF THE KNEE JOINT, REQUIRING AMPUTATION.

A good surgeon, says an old adage, should have an eagle's eye, a lion's heart, and a lady's hand. An aphorism as patent as this needs no demonstration; yet I hold it to be equally true that a good mechanic, with a reasonable knowledge of anatomy, may be a fair operative surgeon. But to affirm that such an one is a good surgeon, would be as absurd as to say that a body without brains is a perfect man.

Simply to amputate a limb may require qualities in which a neighboring butcher may excel a surgeon; but to judge correctly when the sacrifice of a member is necessary to indicate the time most favorable for operation, to execute it according to the instructions of one of old, "*Cito, jucunde, tutissime;*" and then to afford the poor sufferer the best means for recovery, all these necessitate a judgment as judicious as it is rare.

I propose to offer a few thoughts on gun-shot injuries of the knee joint requiring amputation.

Mr. Guthrie tells us that "amputation is the opprobrium of surgery, as death is of the practice of physic." Nevertheless, I am well persuaded from my own observation during the present war, that, while many limbs have been needlessly sacrificed, many lives have been lost from the hesitation of the surgeon—the result either of ignorance or timidity.

The surgery of the field is with propriety much more conservative than in former times. Still many gun-shot injuries so manifestly require the knife, that conservatism, in such instances, is ruin to the soldier and disgrace to the surgeon. It

may not then be inopportune if we consider some of those cases where the splint must yield to the catlin.

John Bell, whose name must ever be mentioned by surgeons with veneration, discourses thus: "As for a wounded joint, we may take the experience of all surgeons, which has established this as a true prognostic, that wounds of the joints are mortal." A more rational treatment of wounds, and a discontinuance of some of the barbarisms of surgery formerly practiced, has reversed this dogma of Bell. However, every surgeon tells us that wounds of joints are uncertain in their results, frequently disastrous in their consequences, and of a gravity which may well excite apprehension.

Throwing aside general injuries of joints, let us confine ourselves to gun-shot injuries of the knee. The ginglymoid and exceedingly complex character of this articulation, as well as its known irritability, must render any extensive injury of its mechanism pregnant with danger. In the field, not unfrequently, extensive destruction of the joint may have occurred, and yet the exterior of the knee present a natural appearance, save the small opening where the missile has entered. Such cases are among the most trying to the military surgeon. The soldier almost invariably refuses to submit to amputation, the injury apparently to his eye being so slight. The surgeon may hesitate, the golden opportunity be lost, and the poor victim may live, only to fall into the arms of death through the exhaustion of suppuration, or the shock of a secondary operation.

Slight injuries of this joint, it is true, may recover, under favorable circumstances, although injuries, seemingly insignificant, often prove fatal. Bear in mind, however, that gun-shot wounds of the knee joint are always severe, and that in the field the soldier must submit to the rough transportation of ambulances, without suitable means of treatment, and that many days may elapse before he may reach a place of erst where the proper appliances can be made. There is no class of wounds where the surgeon should be so decided in his opinion,

and should act so promptly, as in these. I believe that the observation of those who have had the most extended opportunities in the present war, will bear me out in this assertion.

All authorities are agreed in this matter. McLeod tells us that in the Crimea he visited every case of this description that he could hear of, and his testimony is especially valuable. "I have never," he says, "met with one instance of recovery in which the joint was distinctly opened, and the bones forming it much injured by a ball, unless the limb was removed." My own experience of fifteen months in the army, as well as the testimony of many intelligent military surgeons with whom I have conferred, abundantly corroborates the statement of McLeod.

The same authority further states, that although returns show alleged recoveries, he had reason to doubt the correctness of the diagnosis. In all cases where fracture of the epiphysis was made out, death was invariable unless amputation was resorted to.

At first sight one would suppose that the diagnosis in these cases would be easy, while, in point of fact, many instances are exceedingly obscure.

At the Fair Oaks, a soldier belonging to a Pennsylvania regiment, on whom I performed an excision of the left elbow joint, had likewise a wound in the right knee. There were two openings on the sides of the joint nearly opposite each other, one apparently a wound of entrance, the other of exit. Several surgeons saw this case, and, on a casual inspection, decided that the ball passed through the cavity of the articulation. The man being under the influence of chloroform for the excision, a thorough examination of the knee was made, when it was found, to the satisfaction of the surgeons present, that the track of the wound passed around the anterior aspect of the knee. It proved to be sub-cutaneous, and the cavity of the joint was unopened. This patient was sent to one of the hospitals in the rear, and I am not sure that he may not appear in some future report as an example of con-

servative surgery in a wound of the knee joint. Should this prove to be the case, it may be the death warrant of many a brave fellow who really has a penetrating wound of this articulation.

In case the wound is from a minie ball, there is little doubt as to the nature of the injury and its necessities, such wounds being always attended by an extensive destruction of tissue. With the round ball the case is different. It may enter the condyles of the femur, or the head of the tibia, or it may pass near the capsule, and yet in neither of these instances open into the cavity. The track of the round ball may be sub-cutaneous, as in the case already alluded to, swelling may occur from the contusion, and if the case is not seen for some time, the symptoms may seem to indicate a destructive wound of the joint.

Another occasion of doubt to the surgeon may arise from the fact that so long a time may elapse before signs of inflammation supervene. I have met with cases in which the parts appeared natural for a period of from five to ten days, and then fatal inflammation ensued.

The causes of the inflammation are sufficiently evident if we remember the extreme delicacy of the synovial membrane, the introduction of air into the cavity, with its attendant degeneration and the closely compacted tissues of the organ. Other causes are to be found in the large expanse of bone involved, the ease with which purulent absorption may take place, and the difficulty of escape of foreign matter.

In civil life wounds of the knee are usually made by cutting instruments. No foreign bodies are introduced, and under favorable circumstances immediate union and recovery may occur. During the past year a young farmer came under my professional care, who, in falling from a cart, drove the tine of a fork into the right knee joint. The synovia escaped, air entered the joint, indicated by a peculiar churning sound in walking, and the case seemed of the gravest character. Firm bandaging of the joint from above and below, the air thus being

forced out, rest, the recumbent position, and a strict antiphlogistic regimen, gave the man a rapid recovery, without a single untoward symptom.

Balls, however, are lodged as foreign bodies. The contused track of the wound must suppurate, and the air gains constant access. The consequent degeneration is great; foreign bodies cannot be removed, and thus a wound, seemingly trivial, brings the soldier to a desperate extremity. At first no signs of mischief are evident, and the wounded man and his attendants are lulled into a false security. Generally in a week or ten days, inflammation supervenes. In its track there follow long, wasting suppuration, abscess, pyemia, a typhoid and hectic condition, and the inevitable tendency to death. The peculiarity of abscess in these cases is that it forms in the muscles of the thigh, and in many, if not most, instances has no connection with the joint. Sometimes these purulent collections are overlooked, but are none the less dangerous. The pus burrows, the bone is denuded of its covering, and the acrid fluids escape into the areola tissue. In my observations, these collections always occurred in the thigh. Late in the history of the case, there are the usual appearances of white swelling. From what has been said, it may be inferred, that if the articulating extremities have been fractured, there is no resource which offers the soldier any reasonable chance for life save primary amputation. I leave out of the account the question of excision of the knee joint, since, in operations on the field, so much rapidity is required, and the facilities for subsequent treatment so poor, that in my judgment the excision of so large a joint does not afford the same chance for life as an amputation, especially if performed low down. The weight of authority is strong in favor of primary amputation. In the Crimea, the French and English surgeons were agreed in this matter. McLeod saw forty cases in the French hospitals in 1854, all of which died except those who submitted to primary amputation.

It seems, sometimes, cruel to a soldier to lose a limb when

there is only a small wound in the knee, no pain, and to *his* eye, at least, no danger. Innumerable observations, however, are our most reliable guide. The surgeon, perhaps, feels diffident lest he be accused of a desire to "mutilate God's image," and so practices a dangerous conservatism—dangerous, because the facilities for after treatment are wanting in these cases, which even in civil practice are problematical.

Guthrie has seen no case recover without amputation. Larrey reports some successful instances; but they were from slight injuries. Esmarch says, "All gun-shot injuries of the knee joint, in which the epiphysis of the femur or tibia has been affected, demand immediate amputation of the thigh. It is a rule of deplorable necessity already given by the best authorities, and which our experience fully confirms."

The pathological appearances in these cases are pretty constant: there are usually all the signs of chronic disease about the joint, with the addition of an injury. The cartilages may be eroded, the synovial membranes degenerated, and more or less pus present.

Occasionally, recoveries may occur; but even in case of slight injury, the treatment is eminently unsatisfactory. In the most favorable cases the patient must possess a sound constitution and have the best surroundings. At the best, the recoveries are imperfect, and the previous suffering protracted.

"Thinking only of this wonderful recovery," says John Bell, "the surgeon willingly forsakes an uncomfortable rule to lay hold on this one glimpse of hope; while, indeed, if he reasoned fairly, he would perceive that the exception should be lost in the fulness of the general rule, and not the general rule disturbed by the exception."

On the same point, Guthrie says, "If one case of recovery should take place in fifty, is it any sort of equivalent for the sacrifice of the other forty-nine? Or is the preserving of a limb of this kind an equivalent for the loss of one man?" Other authorities might be adduced upon the same point.

The history of cases is significant in this connection. I will

briefly advert to four cases which came under my observation after the affair at Ball's Bluff, at which time I had the honor of being Division Surgeon on the staff of that much abused, but gallant soldier, Gen. CHARLES P. STONE.

CASE I.

Private Sibley, Co. H, 15th Reg. Mass. Vols., was wounded on the 21st of October, 1861, in the left knee, the lower extremity of the femur being fractured. This case came under my observation some days after the engagement, and inflammation had already supervened; pus formed among the muscles of the thigh, and burrowed. The constitutional symptoms were grave, and this soldier, having previously been addicted to excesses, broke down rapidly. Primary amputation was not suggested by the surgeon who first dressed the leg, and his pulse never warranted a secondary operation. His tongue became brown, dry and cracked; the pulse was rapid, and small; he was delirious; emaciation occurred rapidly; the skin grew sallow, dry and harsh; the wound was sloughy, with no sign of healing; pyemia developed; the discharges were at last involuntary; and on November 5th, towards the close of the second week, this soldier died by asthenia.

An autopsy showed a round musket-ball, lodged in the lower extremity of the femur, with fracture. The external wound was small; the swelling of the knee was inconsiderable, and most of the pus was in the muscular interspaces of the thigh. This case was left mainly to nature, the injury apparently was insignificant, and yet it moved steadily on to a fatal issue.

CASE II.

Corporal J. S. Paul, Co. H, California regiment, was wounded in the right knee joint. The regiment to which this man belonged was raised in Pennsylvania, but received its name in honor of Gen. Baker, who commanded the brigade, and who perished on this ill-starred expedition.

Corporal Paul was wounded late in the day, and passed most of the night on Harrison's island, in the Potomac. He

came into the Division Hospital at five o'clock, on the morning of the 22d of October. There was no perceptible shock, and the man himself regarded the injury slight. There was a small wound on the outside of the right knee, but no swelling, and no tenderness. A probe, however, passed into the joint, and on being moved about, gave evidence of injury to the head of the tibia.

I informed him that the limb must be sacrificed. Although opposed to the operation, he yielded his opinion to mine with a good grace, and I amputated at once low down, the patient being under chloroform. This was the first of several amputations in the same ward which I did in rapid succession on that morning; and the cheerful submission of Corporal Paul exercised so good a moral effect on the others, that each seemed to vie with the rest in the coolness and cheerfulness with which they submitted to the knife.

On opening into the joint in this case, I found that the base of the outer condyle of the femur was injured, and that the cup-shaped cavity, corresponding on the head of the tibia, had been penetrated by the ball, breaking off some small fragments of the bone, and lodging near the base of the spine of the tibia. As little shock followed the amputation as the injury, and the soldier made a most rapid recovery. In two weeks all the wound, except two or three small points, was entirely united. At the end of three weeks he got on to crutches, and required no further treatment.

In this case the injury was, to all appearance, insignificant; yet I feel confident that, left to itself, it would have eventuated badly. The wound penetrated the joint, inducing fracture; the amputation was primary, and the case speedily terminated in recovery.

CASE III.

Private Peter Shubert, Co. G, 15th Reg. Mass. Vols., was wounded in the right knee at the same time as the two preceding cases. During the night of October 21st, I saw this case on Harrison's island, and expressed the opinion that amputa-

tion would be necessary. There was no opportunity to do it at that time, however, as orders had been issued to clear the island of all wounded before day break in anticipation of an attack; together with the rest of the wounded, he was taken across the stream to the Maryland shore, placed on a canal boat for Edwards' ferry, a distance of six miles, and thence on an ambulance five miles to Poolesville, where he was placed in a hospital under the charge of Assis't Surgeon A. J. Baxter, U. S. A. Shubert absolutely refused to submit to amputation, saying that several surgeons had examined the wound on the island, and all expressed the opinion that the limb could be saved, except myself. No amputation was performed.

The wound was small, and situated on the outside of the right knee, inclining to the front. With a little assistance he could stand on the leg, and there was no pain nor tenderness. For a week no untoward symptom showed itself. During the second week, however, slight swelling occurred about the knee, which extended rapidly up the thigh, where it became decided. Constitutional symptoms developed rapidly, attended by emaciation. The pulse was over one hundred, the tongue heavily coated, the skin hot and dry, the appetite gone, the bowels constipated, and the general look cachectic. He complained of intolerable pain when the limb was moved, and there was much tenderness about the knee and thigh. About the fourteenth day, the patient complained of rigors, and it was evident that suppuration had taken place in the fleshy part of the thigh.

Being much interested in the result of this case, I ordered the man to be sent to the Division Hospital, where I at once made a puncture into the inside of the right thigh, about three inches above the knee joint, and evacuated a quart of pus. The knee and thigh were then enveloped in a poultice, and the patient put on a strongly tonic and nourishing plan of treatment. The heat of the skin diminished a little, but the other symptoms grew steadily worse.

On the twenty-first day after the injury, the patient pre-

sented the following appearances: the pulse was a hundred and twenty; the tongue dry; the skin alternately dry and moist; there was a tendency to delirium and diarrhœa; and the emaciation, cachectic look and exhaustion had steadily increased. Every thing seemed to indicate a speedy and fatal termination of the case.

Disheartened by the unsatisfactory results of secondary amputations, I hesitated to suggest an operation. A remark of the patient decided me. "I wish," said he, "I had taken your advice at first, and had the leg off, then I should be well like Paul," at the same time pointing to one of the preceding cases, the subject of which was already on crutches in the ward.

Not wishing to increase the inevitable shock of the operation by any mental depression, I concealed from him my purpose, and told him I would put him to sleep, and perhaps the ball might yet be extracted. The preliminary preparations having been made outside the ward, I entered alone, and without any suspicion he took the chloroform kindly, and was soon sound asleep. The attendants immediately came into the ward with the necessary instruments, &c., and I amputated by the double flap, near the junction of the middle with the upper third of the thigh. The femoral artery was admirably compressed by Rev. Mr. Scandlin, Chaplain of the 15th Mass. Vols., a high-toned gentleman, whose practice in this case, as well as elsewhere, was as good as his preaching, and that was far above the army standard. Two medical gentlemen assisted me, Brigade Surgeon D. W. Hand, of Minnesota, and Assistant Surgeon S. Foster Haven, of the 15th; the latter, unfortunately for the service, since killed, having fallen a martyr to his professional zeal at the battle of Fredericksburg.

As soon as the artery had been carefully compressed, the limb was elevated for a short time, so as to drain it of its venous blood. The amputation was then done quickly, going above the inflamed muscles, and the vessels were tied without letting up the compression, so that the loss of blood was tri-

fling, less, I think, than in any amputation I have ever seen. Nevertheless, the shock almost destroyed him. At one time respiration ceased, he became pulseless, and seemed moribund. Irritation of the epiglottis with my finger, a sudden draught of air, and the dropping of raw whiskey into the mouth, had the effect of re-establishing these functions. He aroused from the chloroform with a pulse of one hundred and forty, and was profoundly astonished on being informed that his leg was off. Plenty of sutures were employed, and the stump elevated with a simple water dressing. A regular relief of nurses was established, by which he had constant attendance night and day for several weeks. Brandy and beef extract were exhibited every hour, and morphia to relieve pain.

At the end of twenty-four hours the stump had suppurated, and the odor was so offensive that gangrene seemed imminent. I removed the stitches, permitting the flaps to gape, and applied a cloth wet in whiskey to the raw surfaces, with a disinfectant. This was changed every two hours. The pulse was still one hundred and forty. The patient looked feeble, was delirious, and sang and whistled with all the vivacity of a Frenchman.

On the third day after the amputation, the patient vomited some bilious-looking matter, and had an exacerbation of fever. The femoral vein became rapidly swollen and tender. He looked weak and irritable, and had a small, rapid pulse; but he had a good appetite, and there was no pain, no sickness.

The ligatures all came away within five days, but the flaps still looked unhealthy, being covered with a partially disintegrated lymph, and the discharge was very offensive. The same dressing was applied to the stump as before, and a spirit lotion with opium over the vein.

During the second week, the skin was hot and dry, the pulse more rapid and compressible. He complained of pain in the other leg. His tongue was heavily furred; he vomited again at intervals, and the pain and tenderness over the femoral vein were pronounced. The vein itself was now nearly as large as

the index finger, phlebitis evidently had occurred; Shubert became extremely sallow and cadaveric; the skin presented a yellow, earthy tint. During the third week, diarrhœa supervened; the pulse ranged from one hundred and forty to one hundred and fifty; the skin was covered at intervals with an offensive moisture, and the exhaustion and delirium seemed to threaten a speedy dissolution.

During these three weeks, brandy and quinine, with beef extract were exhibited every hour without fail. The dressings were renewed every two hours, and the utmost attention was paid to cleanliness and ventilation. When vomiting occurred, injections were resorted to, and sponges, saturated with quinine and alcohol, were kept in the axillæ.

For twenty-one days I confidently expected that Shubert would die; his emaciation was extreme, and when asleep, he looked wholly inanimate.

Early in the fourth week some slight signs of improvement showed themselves. The pulse came down to one hundred and twenty, the tongue, which had been brown, dry and cracked, softened and grew moist. The skin assumed a more natural look and feel; the bowels moved naturally, and the appetite began to waken up. Bright red granulations soon appeared through the dirty white shreds of lymph on the flaps, and the femoral vein lost its tenderness, and, to some extent, its swelling.

He was now convalescing, but very slowly, and did not seem safe until six weeks after the amputation. At the end of three months from the time he lost his leg, he was able to hobble out of his ward. I heard of this man in Canada a few months since. He sent me a kind message, and the assurance that he was now entirely well, having had no trouble since I saw him last, save from some exfoliation of the bone.

An examination of the joint in this case, after amputation, showed that a round musket ball had entered the articulating surface of the external condyle, the bone being only slightly

splintered. It seemed incredible that an injury apparently so slight, should have resulted so disastrously.

I have been thus minute in describing Shubert's case, because it is the only instance of a secondary amputation, after gun-shot injury of the knee, followed by phlebitis, that I have known to recover. Mr. Guthrie relates several similar cases, where secondary amputation was followed by phlebitis, and in all a fatal result ensued.

CASE IV.

A soldier of the 20th Mass. Vols. got a wound of the knee joint in the same engagement as Shubert. Inflammation followed, and the man's condition was very similar to that of the case last described. A secondary amputation was done by the accomplished surgeon of the regiment, Dr. Hayward, but the man died by asthenia.

Cases like those I have just described could be multiplied indefinitely from the experience of army surgeons. I have related them somewhat in detail, because I believe that each of these instances embodies an aphorism in military surgery, which the surgery of all wars corroborates. The points which I would impress are these:

1st. That gun-shot injuries of the knee joint involving the articulating surfaces, or complicated with fracture, are inevitably followed by a destructive inflammation, an extensive suppuration, mainly in the thigh, a typhoid condition, and death. The case of Private Sibley is an instance in point.

2d. That such injuries of the knee joint require primary amputation, and the previous condition of the soldier having been good, and the shock moderate, a favorable result may be assumed with confidence, as in the case of Corporal Paul.

3d. That secondary amputation, after suppuration has occurred, may save the soldier, as in the case of Private Shubert, but is much more likely to result fatally, as shown by the last case adverted to.

I am well aware that the above propositions may seem to advocate a harsh principle, yet it has a few exceptions, which,

however, like all exceptions, only prove the rule. Thus a compound fracture of the patella may occur, and yet the remaining bones of the articulation be uninjured. In such instances it is good surgery to wait.

A ball may strike the centre of the patella, and pass through the joint between the condyles. Under such circumstances the limb will generally be lost, since the spine of the tibia is very liable to be fractured, and the crucial ligaments, with their synovial covering, lacerated. If the popliteal artery happens to be divided, there cannot be the shadow of a doubt as to the propriety of immediate amputation.

Sometimes a ball may enter the cavity of the joint, and not injure the articulating extremities. If it can be removed without inflicting further injury, the limb may be saved; but the ball remaining as a foreign body, there will be no resource but the knife. Without doubt a ball may lodge in the reticulated structure in the articulating extremity of either bone, and the cavity of the joint not being opened, recovery take place. If, however, the synovial membrane is ruptured, the leg will be lost.

Of course, injuries of the knee which partake of the character of incised wounds, whether made by a ball or a cutting instrument, admit of delay. Such, so far as I am aware, are the only instances of gun-shot injuries about the knee, which hold out any hope to the conservative surgeon. Even in the majority of these instances, the soldier only too frequently comes to regret that amputation was not done at the outset.

It only remains that I should allude briefly to the plan of treatment most favorable for recovery when an effort is made to save the limb. In no class of wounds is a strictly antiphlogistic plan of treatment more essential than in these. Of all the necessary conditions for recuperation, absolute rest is most to be insisted on. Unfortunately, battles are not fought for the convenience of wounded men or surgeons, but to gain a position and defeat the enemy. Thus it often happens that the sufferer is left in a most inaccessible locality, whence he

must be removed by the litter, and perhaps for days trust to the tender mercies of ambulances, railroads and steamboats. When at length he reaches a general hospital, the period when rest was so absolutely essential has passed, and the fires of a destructive inflammation are almost certain to have been lighted up.

The soldier must breathe only a pure air, and he must be placed in a position wholly free from endemic diseases. Any neglect of these conditions must render the whole treatment abortive. The limb should be placed on a straight splint, and some authorities advise enveloping the knee in ice, maintaining it persistently many days. This plan of treatment has been much insisted on by the French surgeons. The application of the ice, however, is to be cautiously made, since otherwise the depression of vitality in the integument of the part may result in gangrene. For myself, I prefer applying a piece of linen wet in equal parts of the saturated tincture of aconite and the tincture of opium. This may be repeated as often as the cloth becomes dry, or the knee hot. Very early after the injury, this dressing may be covered with oil silk with advantage. The more completely the natural processes of the part can be quieted or benumbed, the less the liability. If, however, inflammation supervenes, leeches should be applied freely and repeated often if the symptoms persist. Evaporating and anodyne lotions should be constantly applied, or the ice, as the indications may seem to warrant.

For the first few days the diet should be low; but I am well satisfied that, as a general rule, gun-shot wounds do not bear starvation well. Sedatives and evacuants are to be employed *pro re nata*. Pus having formed, early evacuation is to be promoted, and the constitutional treatment should be tonic and supporting.

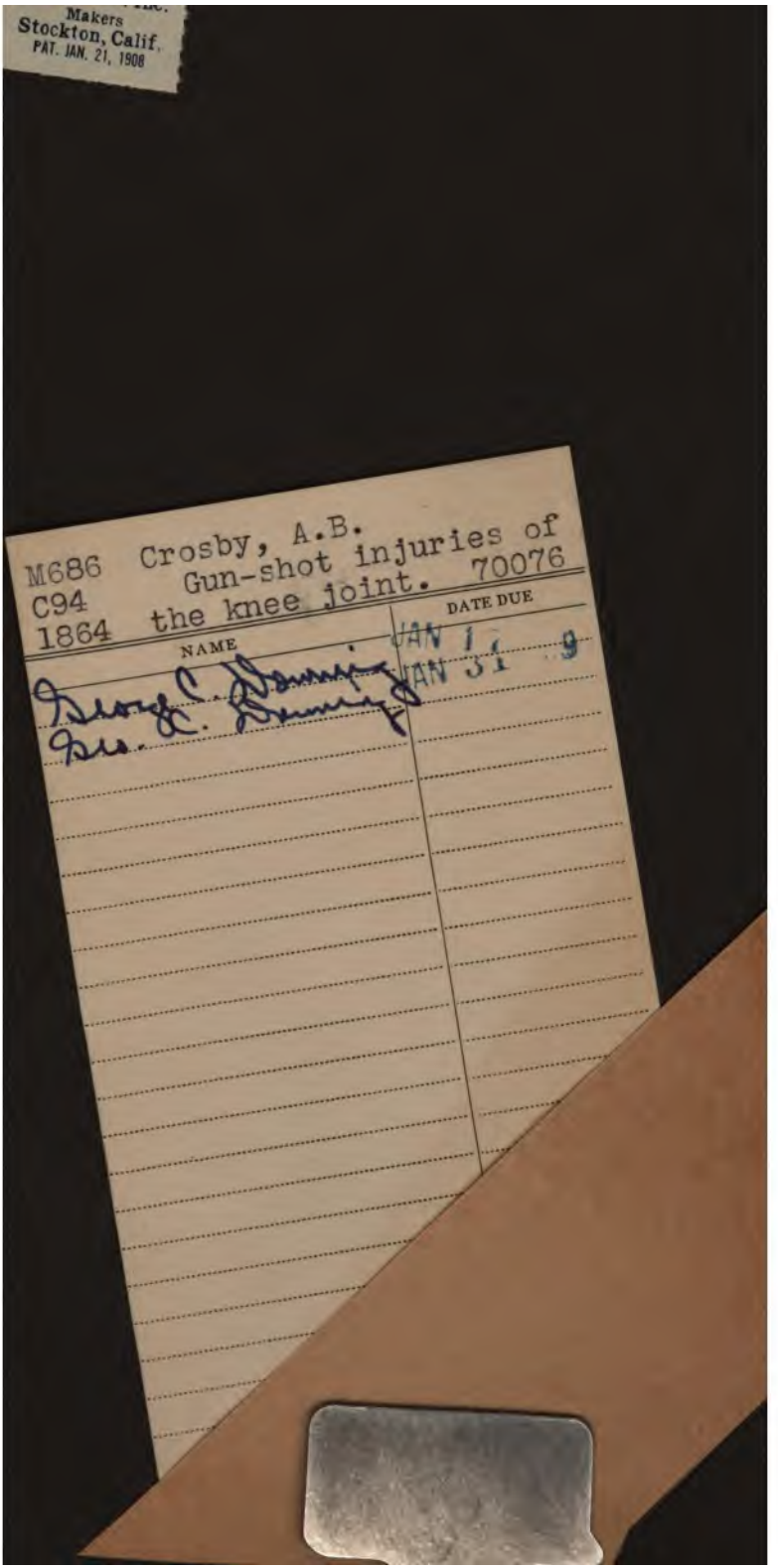
Finally, the hereditary tendency of the soldier is to be taken into the account. A rheumatic, gouty, syphilitic, or strumous taint may, if disregarded, render all conservative efforts of no avail. And above all, in deciding for the soldier in these

cases, let us bear in mind that a gun-shot wound of the knee is worse than a corresponding lesion of the ankle, the shoulder, or the elbow.

I cannot, perhaps, more fittingly close this paper than by transcribing the brief but significant record of a case related in the able and instructive "Commentaries" of Mr. Guthrie:

"Col. Donnellan, of the 48th regiment, was wounded in the battle of Talavera, in the knee joint, by a musket ball, which gave him so little uneasiness that he could scarcely be persuaded to proceed to the rear. At a little distance from the fire of the enemy, we talked over the affairs of the moment, when, tossing his leg about on the saddle, he declared he felt no inconvenience from the wound and would go back, as he saw his corps was very much exposed. After he had staid with me for a couple of hours, I persuaded him to go into the town. This injury, although at first to all appearance so trifling, proceeded so rapidly as to prevent any relief being obtained at last from amputation, and caused his death in a few days."

Hanover, N. H., June, 1864.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